Surf Clam Aquaculture in Massachusetts

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Final Report

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Surf clams (Spisula soliddissima) are a promising aquaculture species, especially in colder northern waters. This clam is very fast growing, and is adapted to high energy cold water environments, such as are typically found in Cape Cod Bay, Massachusetts. Surf clams are active and feeding at temperatures close to 1 C. These clams can be grown in one year, as opposed to 30 months or longer for hard clams, and are suited to locations which often are not suitable for any other species.

The focus of this project was to evaluate culture methods, growth rates, site requirements, and profitability of surf clam culture in three Massachusetts locations. The Resource, Inc. has had extensive experience with shellfish culture in a wide range of environments throughout New England, and conducted the project with cooperating private growers, as well as four municipalities. Growers in Brewster, Wellfleet, Truro, and Provincetown all provided experimental sites, equipment and labor, while a local hatchery provided seed and nursery culture. Growing methods and growth data from Maine, Canada, New Jersey, Delaware, and Georgia were also obtained and compared to the methods developed in this study. It should be noted that methods differ widely from place to place, primarily as a response to local site conditions. We found that many of the concepts and ideas from other sites, although important in those locations, did not apply here. Even more so, some methods usable in some Cape Cod towns cannot be used in others. We have attempted to outline the basic biology and characteristics of this species so that growers have enough information to work with these animals on their own sites, given the appropriate gear modifications.

We would like to note that this project could not have been carried out without the assistance from the Shellfish Departments and participating growers in Brewster, Eastham, Wellfleet, Truro, and Provincetown.

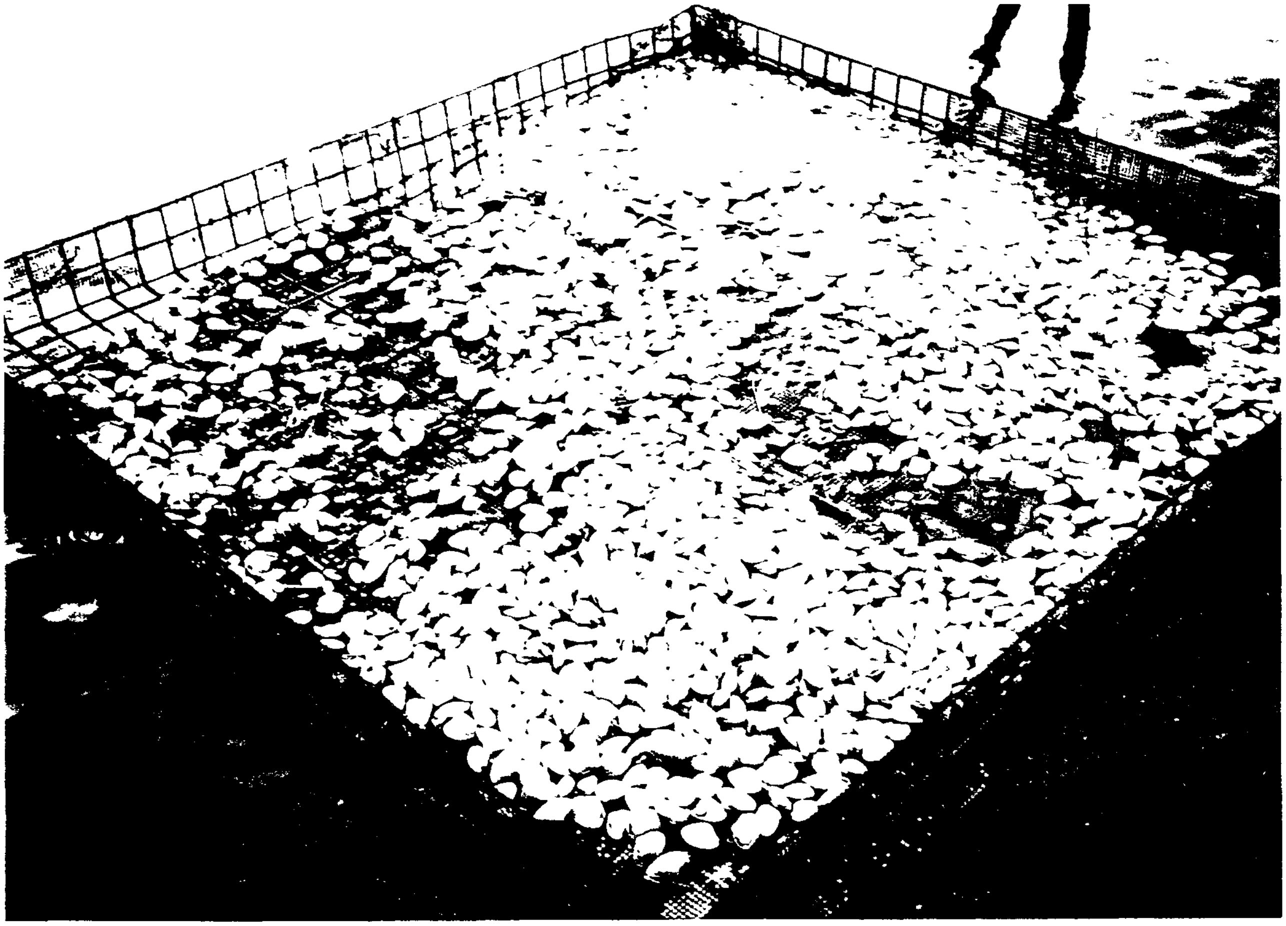

Figure 1. Surf clams harvested after six months.

METHODOLOGY:

Clam seed was produced by Aquacultural Research Corporation, a shellfish hatchery in Dennis, Massachusetts. Clam seed was held in an upweller system by the hatchery, and provided to growers throughout the season (May-October) at approximately 4-6 mm. Clams were transferred directly to on-bottom growing boxes, made of 1 inch mesh vinyl dipped wire. These boxes were 3′ x 5′, 4 inches deep, and were fitted with a scrim (fabric) liner to hold sand. Nursery boxes are shown in Figure 2. Boxes also had 1/6 inch mesh tops held on with clamps made from 1 inch polyethylene hose. Tops were held up with a small float. Hose clamps are made by cutting the hoses to fit the dimensions of the box, and ripping them the long way on a table saw. The slit in the hose then slides over the rim of the cage, securely holding the covering mesh in place. These are fairly standard nursery boxes also used for hard clam culture throughout Cape Cod. Although sizes vary, the boxes need to be able to hold sand, and be completely enclosed to keep out predators. Clams were planted at about 500 per square foot (7,500 per box), and monitored throughout the growing season. Clams were also planted at over 1000 per square foot for holding purposes.

Figure 2. Shellfish nursery boxes, Brewster, MA.

Previous experiences with these clams meant modifying all nursery cages accordingly, as the small seed is highly mobile and will escape if there is an opportunity to do so. Small seed has been observed to crawl over 30 cm in one hour, and will fit through any mesh large enough. Seed clams constantly move around inside the cage. To prevent escape, we added a second cover made from window screen, which was installed underneath the outside 1/6 mesh cover. Both were held on using the same hose clamp. The window screen also kept out most smaller predators, but restricted water flow. Screens were removed in July when clams were large enough to be retained by the outside cover alone.

Clams were grown in the nursery boxes until October, and either bottom planted under 3/8" netting, or transferred to overwintering containers. Netting for bottom planting is constructed by attaching lead line to the perimeter of the net, using plastic cable ties or hog rings. Net dimensions are 14′ wide, and cut to length, generally about 50′ to 60′. A smaller mesh net is also available (1/6"), but is more susceptible to fouling. The edges of the net are then dug into the bottom about 4 inches, and held in place with 12" long U hooks, made from 1/4" diameter rebar. These are commercially available from several local suppliers.

Overwintering containers were constructed from 1/6" mesh, by folding a 12′ x 6′ piece in half, forming a 6′ square envelope. The bags were sewn together, filled with clams, and staked to the bottom at the four corners. A small float is attached to the center of the top layer of mesh. This keeps the cover several inches above the clams. These bags gradually fill with sand, allowing the clams to grow in sand, entirely enclosed by mesh. The bags can be lifted at any time by one person, for harvesting or transplanting.

RESULTS:

Seed clams were grown in nursery boxes until October 1996. In the 1995 season, these clams averaged 40 mm by late October, and continued to grow until early December. About 15% were marketable after one season, with the remainder being slightly too small (about 35 mm). These were overwintered in mesh bags and exceeded 2 inches in early summer of 1996. We found that the clams were active at very low temperatures (about 1 C), and that overwintering survival, even under adverse conditions, was excellent. This is in part due to the activity level, since the clams remain active and do not become buried or smothered. Overwintering methods were also worked out during this time, with clams successfully overwintered in bottom boxes, ADPI 1/2 inch polyethylene mesh bags, and directly in the bottom. One year clams, at sizes over one inch can be field planted, and did not move significantly during the eight months following field planting. Smaller seed will move almost immediately. Small seed can be retained in the bottom by the use of boards dug into the edge of the run. Protective netting is then attached directly to the top edge of the board, thoroughly enclosing the planting area. We found that small seed could (and did) migrate laterally in all directions. If the seed is small enough to get through the protective netting, it will do so in a matter of weeks. Boards prevent this, as long as the surface netting is the appropriate size.

Growth rates were observed to be sporadic. Clams would not grow for two to three weeks, then suddenly almost double in size, followed by another slow growth period. These growth spurts did not correlate with growth in other shellfish, such as oysters or hard clams. Maximum growth was observed in late September-early October in both years. Increased flow, coupled with lower densities in the hatchery situation improved growth, but was not the cause for slow growth throughout the year. These clams are capable of enduring a wide range of unsuitable conditions for long periods of time, despite literature to the contrary.

Although direct planting in the bottom is the fastest and most inexpensive method, seed clams under 10 mm require some sort of nursery culture, as they are highly susceptible to a wide assortment of small predators, especially crabs. Small hermit crabs in the 3/4 inch size were present in most of the study sites (Figure 3). This is the primary reason that enclosed nursery boxes are used. Any crabs or other predators that do get into the boxes can be periodically removed by hand. Young of the year green crabs were very abundant in two of the sites, but were excluded from the cages by using window screen as covers. Even with window screen, some crab larvae were able to get into the cages, and grew inside. These were too small to cause any damage, and were removed when the cages were harvested.

Figure 3. Hermit crab with seed clam at planting.

The 1996 season was substantially different than 1995, with below normal water temperatures, and an erratic food supply in the water column. Water temperatures in Chatham did not reach 70 F until August. In addition, seed clams did not grow as well in the hatchery, creating delays in field planting the seed. We hypothesize that differences in the algal species composition were responsible, as the clams are active and growing in early spring when water temperatures are still in the 50 F range.

Seed became available not only later in the season, but also at a smaller size. The growing methods were consistantly successful in spite of these unexpected factors. Average size at the end of the 1996 season still exceeded 30 mm. As long as clams could be contained in the nursery box with a small enough mesh size, and water flow maintained, growth and survival were good. Note that small meshes tend to foul faster, and require more cleaning, and that the covers were removed two to three times during the summer to check for small predators. Such predators were removed by hand. By mid-summer, the inner layer of window screen was removed, allowing for much better water flow in the box. At this time, the clams had grown to 15 mm or so, and were large enough to be immune to young of the year green crabs, which at this time were only 6-7 mm. In addition to every species of crab endemic to the area, moon snails (<u>Polinices</u>) were also found. Although two or three snails occassionally were seen in a box, these were removed.

COMMERCIALIZATION:

The initial nursery phase of shellfish culture generally experiences the highest losses. This is primarily because smaller shellfish are more susceptible to a wide range of predation, and is generally the most difficult phase for new growers. The nursery methods developed for this project reliably produce seed in the 30-40 mm range after one season. Although some clams were in the 50 mm range after one season, and could be sold at this size, an effective overwintering strategy is still required, as the entire crop does not reach this size at the same time.

Note that surf clams are cold tolerant, and can successfully be overwintered at a size of 8-10 mm. If seed became available in late summer, growers could still achieve an 8-10 mm size by November, and overwinter their own seed at a relatively small size. Growers would then have their own large seed in March of the following year, instead of June or July, and could achieve 100% sales that fall (one year from purchase). In addition, it should be noted that most hatcheries are running at or near capacity in late spring and early summer, and may not have the space or labor needed to grow a completely separate crop. A later spawn (for surf clams) would be much easier for most hatcheries, as well as growers.

Given this model, even exposed sites could be used seasonally, as long as a deep water overwintering location was available. It also provides an opportunity for nursery growers with a deep water overwintering site to supply 6 month old seed in the spring of the year to other growers working on seasonal sites. This seed would be grown out for one summer, and sold late in the fall of the same year.

First year seed obtained in June of 1995 overwintered with approximately 90% survival, even under a variety of extreme conditions. Clams grew well in April and May (1996), and were ready by Memorial Day, 11 months from receiving the seed. Growth then slowed to a standstill in mid-June. One year clams are shown in Figure 4.

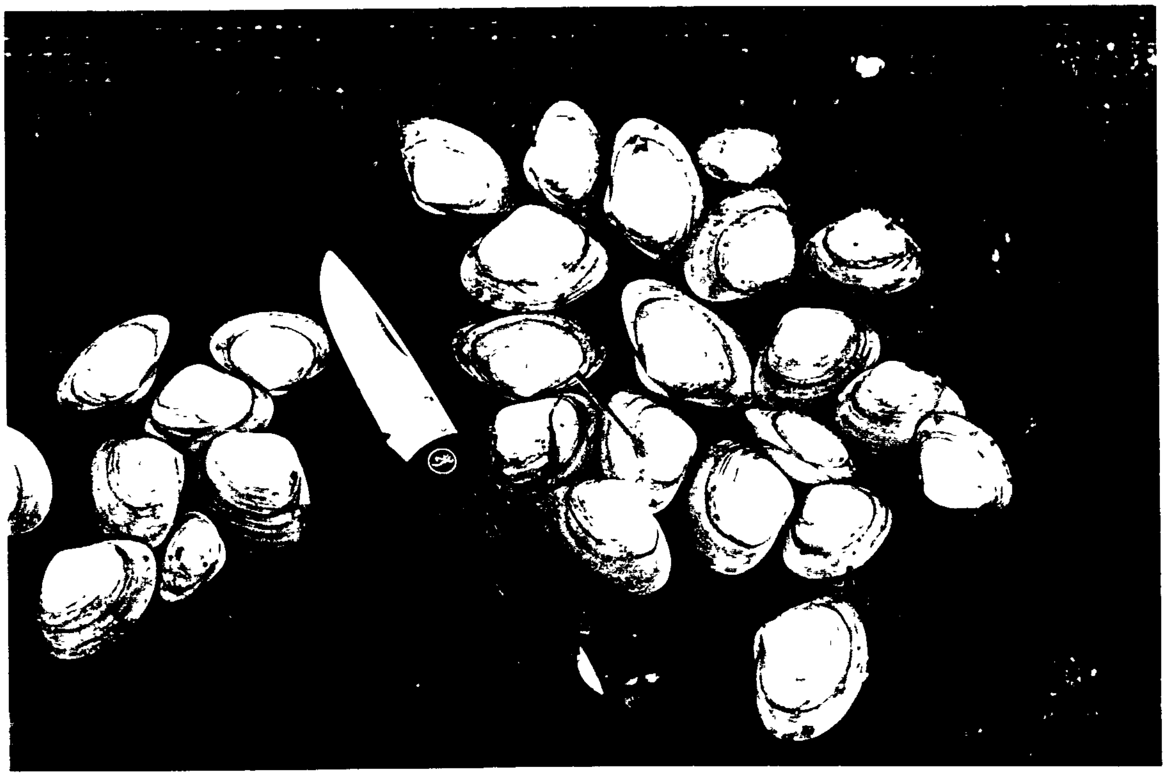

Figure 4. Surf clams after 11 months, ready for market.

The high mobility of small seed is an important factor in understanding culture methods for this animal. Although the seed will escape if it can, mobility is a major benefit in many situations. First, the clams cannot be buried, as they will readily dig out. Second, if wind or tides shift all of the seed into one corner of the box, they will redistribute themselves accordingly. Finally, only a minor amount of sediment is needed; some clams were even overwintered in bags held in the water column with no sediment, with over 90% survival. Once the clams are over one inch, mobility is slightly reduced, and bottom planting under netting can be done successfully.

For larger scale field planting, boards dug in around the perimeter of the planted area may be helpful. The top netting is then attached to the board frame. This prevents lateral movement of field planted clams, prevents lateral movement of predators into the raceway, and also holds the netting in place. Although we have successfully used netting with lead line attached to the perimeter, the lead line needs to be trenched to at least 6 inches. We are also evaluating the use of 6'x 6' mesh bags for final growout.

Surf clams have different site requirements than other shellfish. A prime natural habitat is Cape Cod Bay. Warmer enclosed ponds with minimal water flow are poor site choices. For example, surf clams are found in Nantucket Sound, but not in any of the coastal ponds along the south side of Cape Cod. There are a number of reasons why a certain species may or may not be found in an area, only some of which can be managed to allow for aquaculture of this species. Although predation is often responsible, and can be controlled, physical factors cannot. Surf clams tend to do best in areas with high water flow and coarse sand, and are not well suited to calmer environments, especially those favoring siltation. Note that temperature does not seem to be a limiting factor, but that the clams did not do well in muddy, high silt load areas. Clams also grew better in subtidal sites, although survival on intertidal sites was comparable. Any factor which reduces current flow needs to be considered. For the purposes of the first season nursery culture of small seed, ease of site access and gear maintenance should have priority.

The importance of the vast differences in site characteristics cannot be ignored. The only real way to evaluate a site is by trying it out, as there are many factors which are site specific that may not exist elsewhere. Site conditions may require gear modifications or a different management approach, which may take several seasons to fine tune. Note also that each growing year is different.

We have identified strong markets for this clam in many sections of the country, at a value at or near $0.10 each. Small surf clams are sometimes marketed as "butter clams", but this is a misnomer, as there is actually a true butter clam marketed as such.

In Massachusetts, and most other coastal states, there are minimum size laws for the wild harvest of this clam. Although these clams can be grown here, they cannot be sold at a sublegal size in states having a size limit (including Massachusetts). Therefore, the entire market at this time is in landlocked states having no minimum size laws. In terms of the natural resource management regulations, a similar quandary has occurred many times with other species, such as striped bass. Although there are good reasons for size limits in managing natural (wild) stocks, these have nothing to do with aquaculture farmers. We note that aquaculture is a form of agriculture, and must be regulated appropriately. Any grower interested in this species should be aware of the regulations pertaining to it.